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APPENDIX C

**SUMMARY OF POSTER ON "HAZARDOUS WASTE STABILIZATION
WITH CLEAN-COAL TECHNOLOGY ASH RESIDUALS," TO BE
PRESENTED AT THE IAWQ 18th BIENNIAL INTERNATIONAL
CONFERENCE, SINGAPORE, JUNE 23-28, 1996**

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Preproposal

Stabilization of DOE Hazardous Wastes with Clean-Coal Technology By-Products

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The objective of this research is to evaluate both the long term and short term stabilization of DOE metal-containing hazardous wastes with clean coal technology by-products. This work builds directly on a currently funded DOE/METC project with the University of Pittsburgh (prime contractor) in conjunction with Mill Service (a centralized waste treater), and Dravo Lime Corporation.

BACKGROUND: The overall objective this project is to provide useful information and data on the ability of by-products from advanced Clean Coal Technologies (CCT) to be used by the DOE in an engineered effort to stabilize and reduce the risks from exposure to selected metal containing hazardous wastes. Studies fall into two categories:

- (i) observation of the ability of CCT to stabilize and solidify characteristic toxic/hazardous metal-laden wastes (*and other DOE metal containing wastes*) over the near term via conversion of such wastes into a non-hazardous form by means of pozzolanic type reactions with by-products, and;
- (ii) characterization and understanding of the longer term environmental and physical stability of the resultant solidified matrix in terms of potentially time dependent physical and chemical/toxicological leaching characteristics taking place due to slow solid phase crystalline reactions.

BY-PRODUCTS The Clean Coal Technology (CCT) Program is a DOE-Utility cooperative effort to demonstrate a new generation of innovative coal processes, which are environmentally cleaner and more efficient than conventional coal-burning techniques. In dry CCT systems, a calcium-based sorbent (usually slaked lime, limestone, or dolomite) is injected directly into a furnace, ductwork, precipitator, or scrubber vessel that produces powdered or granular by-products, as opposed to the slurries associated with traditional wet scrubber systems. All these processes produce a by-product which is removed in the particulate control equipment. Dry by-products from lime or limestone injected into the furnace, such as in FBC systems, have neutralizing, sorptive, and cementitious properties that make them interesting as potential reagents for hazardous waste stabilization because of their high free quicklime (CaO) and anhydrous calcium sulfate (CaSO_4)

contents. The specific composition of a particular type of by-product varies widely depending upon the CCT process employed, the coal and sorbent composition, and the plant operating conditions. For purposes of this research, the University will initially select CCT byproducts which have already proven to be useful for the metal-sludge and metal-soil stabilization purposes, followed by selection of additional CCT materials in conjunction with DOE personnel. The initial group of clean-coal technology by-products include:

- 1- Dry Scrubber Residue, supplied by CONSOL Inc. This material is from a spray drier at the outlet of a pulverized coal boiler burning high-sulfur eastern coal. Within the process, ash laden flue gas enters the bottom of the spray drier and all of the sulfur-capture residue rises through the upper port with the fly ash. The residue contains 45% fly ash, 36% $\text{CaSO}_3/\text{CaSO}_4$, 10% $\text{Ca}(\text{OH})_2$, 2% CaCO_3 , and 7% other inert material with moisture content of 2% or less; and
- 2- Residue from a Coal-Waste-Fired CFBC operated by the Ebensburg Power Company. Fly ash is removed in a ten-segment baghouse and conveyed to a silo with the resultant mixture being 30% bottom ash. Thus, the by-product is a relatively coarse material containing 82% ash, 12.5% limestone equivalent and 5.5% $\text{CaSO}_3/\text{CaSO}_4$.

CCT materials that will not be considered further for this proposal, but are part of our existing effort include:

- Residue from a Coal-Fired Pressurized Fluid Bed Combustor (PFBC) at the Tidd Station of Ohio Power Company (this materials will no longer be generated and will not be considered further), and
- Residue from a Coal-Fired Circulating Fluid Bed Combustor (CFBC), supplied by Anker Energy Corporation at its Thames River Plant near Uncasville, Connecticut. The residue is a relatively coarse material, as it contains both bottom and fly ash from the boiler, and contains 45% limestone equivalent, 28% ash and 27% $\text{CaSO}_3/\text{CaSO}_4$. Special permission from the generator will be required for this material.

The proposed research will use one or both of the CCT materials above in conjunction with other candidate CCT by-products as can be identified later.

- **Preliminary Results:** Results to date have shown that CONSOL spray drier CCT by-products exhibit across-the-board superior lead stabilization properties for all hazardous wastes utilized. The waste products indicated on Figure 1 were obtained from Mill Service Company clients. The

stabilization ability of such CCT materials with DOE hazardous wastes must still be determined.

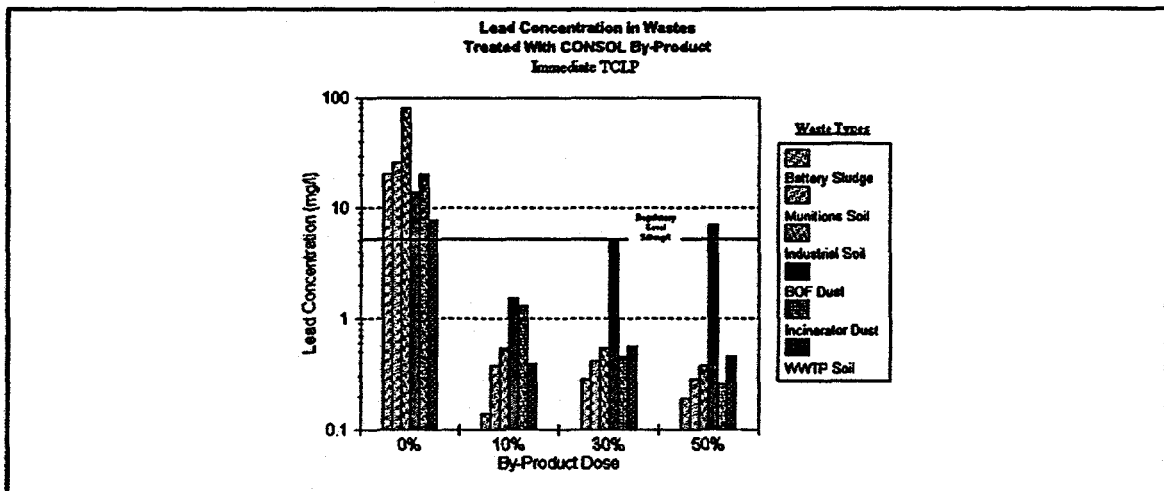


Figure 1
Successful Lead Stabilization

In addition, compressive strength properties of solidified materials will be determined (*equipment contained within the Department's Geotechnical Engineering laboratory*) to supplement measured leaching potential thus allowing considerations of reuse opportunities for treated materials.

Objective 2: Longer term stabilization: Regulatory and risk assessment acceptability determinations are often made based on information from short term leaching and stabilization experiments. In contrast, recent data at the University of Pittsburgh shows that in some cases leachate concentrations (and thus ingestion risks) resulting from stabilized/solidified matrices are elevated over time, probably as a consequence of solid phase reactions continuing to take place.

Tables 1a & 1b illustrate this point by showing current results of leachate concentrations measured just after stabilization, and made after waiting 90 days after stabilization and solidification. Such chemical (and physical) alterations over time may be indicative of critical but slow aging processes taking place within the solid phase. Both short term and longer term (> 90 days) controlled experimentation using DOE wastes are proposed for this new effort.

**Evaluation of Lead Stabilization at 90 Days
Hazardous Waste Mixtures Treated with
Clean Coal Technology By-Products
Lead TCLP Concentrations (mg/L)**

Table 1-a: Stable Mixtures over Time-Pb (mg/L)

Stabilization Time (days)	Tidd with Battery Sludge	Tidd with Waste Soils	Tidd with Munitions Soil
0	4.1	2.3	1.2
90	0.7	0.6	1.2

Table 1-b: Mixtures showing Increasing Leachate Concentrations over Time-Pb (mg/L)

Stabilization Time (days)	CONSOL with Munitions Soil	Ebensburg with Waste Soil	Ebensburg with Munitions Soil	Tidd with Industrial Soil
0	0.28	0.31	5.6	1.7
90	0.90	6.0	9.0	14.0

This is a significant issue since, as shown on Table 1b, there is a real potential that environmental management decisions based on immediate or 24 hour TCLP measurements (after initial stabilization) may be in error as a consequence of inherent longer term aging reactions.

For purposes of this research, specially collected and stabilized samples of solidified DOE hazardous wastes will be stored in humidified chambers for the duration of the project (for time periods on the order of 1 to 2 ½ years). Solidified materials will be examined at periodic time intervals using XRD analysis (*located within the Department of Materials Science*) to determine the nature of slow solid phase crystalline reactions taking place. Such reactions will be compared and correlated with leachate and compressive strength determinations both from short term and longer term evaluations.

SUMMARY and EXPECTED OUTCOMES

- Research will examine the use of Clean Coal Technology by-products (CCT) as a chemical feedstock for the stabilization and leachate attenuation of DOE hazardous wastes.
- Based on preliminary results of current research, a number of CCT materials are identified as being particularly promising for stabilization and leachate attenuation.
- Critical issues are identified of both short term (24 hour) stabilization/leachate attenuation reactions, and "aging" reactions which must be evaluated and understood to assure longer term decreased risk for the public and workers associated with DOE environmental management and restoration actions.
- This research is uniquely multidisciplinary in nature involving faculty and expertise from the areas of environmental engineering, energy resource engineering, geotechnical engineering, and materials science and engineering. Faculty and necessary laboratory facilities are all located within the School of Engineering, University of Pittsburgh.